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AUTHENTIC DOCUMENT AND METHOD OF MAKING

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AUTHENTIC DOCUMENT AND METHOD OF MAKING

FIELD OF THE INVENTION

The invention relates generally to the field of authenticating documents and in particular creating a print medium with an identifying physical

5   anomaly.

BACKGROUND OF THE INVENTION

An article from the Hardcopy Observer, "Pitney Postage Plan Wins Approval, Escher Tries New Approach", January 2000 announces a technology that enhances the security of postage documents by forming a signature of the

10   paper fiber over a localized region and then printing this signature elsewhere on the envelope in the form of wavy lines.

Since the image obtained from scanning paper fiber is random, it is very likely that no two envelopes ever have or ever will possess the same fiber structure. Therefore, every envelope may be considered to have a unique

15   identifier and may be used to uniquely identify every letter. The technique requires that the fiber signature be printed and encoded as a series of wavy lines elsewhere on the envelope. How the fiber signature is distilled from the fibrous region is not disclosed. A significant advantage of this system is that it is unlikely that a counterfeiter would discover the process needed to duplicate this process.

20   Simply copying the envelope is not sufficient because modern copiers do not copy the fibrous structure. The copier resolution is simply not high enough. By providing an information channel directly related to the unique aspects of the paper itself, the ability to counterfeit is minimized.

However, the technique described above has a significant

25   shortcoming. The requirement is that the fibrous signature is used as the unique identifier. The fibrous signature relies on the construction of the paper base of the envelope. Other medium such as photographic paper, thermal transfer, and inkjet all have different surface characteristics. In some cases these media do not have a paper base or a paper base that is close to the surface where the fiber structure is

30   available for scanning. These media generally have a receiver layer constructed

using a polymeric material. The polymeric materials used to form the receiving layer cover the paper base obscuring the fibers. The fibers themselves are susceptible to damage from outside elements such as water, abrasion, etc. In addition the technique does not provide a separate record in the form of a digital

5   file of the scan of the envelope's fiber or link that file back to the envelope.

Verification Technologies, Inc. discloses on their Website at http://www.netventure.com/vti/isis/main.htm a method for identifying valuable objects by capturing a unique series of microphotographs and a log of how they are collected. The microphotographs are then used to verify the authenticity of the

10 objects.

In each of the cases cited the feature being scanned or photographed already exists as a part of the object. The features are not purposely created during the time of manufacture for the sole purpose of proving authenticity. Nor is any attempt made to artificially create the mark or produce a

15 mark that is physically robust.

It is an object of the present invention to provide a high-resolution scan of the physical indicia identifier creating a unique digital representation of the physical indicia identifier.

It is a further object of the present invention to provide a

20 cryptographically secure method for invisibly hiding (or embedding) a message derived using a texturally derived signature from the anomaly. In the case of printed image on the media, the need for a visible representation of the data to authenticate an image is eliminated.

It is another object of the present invention to provide a unique

25 physical indicia identifier by embossing, etching or printing a pattern on the front or back surface of a media.

It is a further object of the present invention to provide a high-resolution scan of the physical indicia identifier creating a unique digital representation of the physical indicia identifier.

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SUMMARY OF THE INVENTION

In accordance with one aspect of the present invention there is provided a method for making an authenticable original document on a sheet of media, the sheet of media having a physical indicia identifier and an identification number printed thereon, comprising the steps of:

obtaining a high resolution scan of the physical indicia identifier and creating a digital file of the high resolution scan;

associating the high resolution scan file to the identification number printed on the sheet of media,

storing the high resolution scan file to memory,

creating a digital text file to be printed on the sheet,

distilling the digital text file,

creating a message image using the distilled text file,

combining the message image with the high resolution scan file of physical indicia identifier so as to create a dispersed message, and

printing the dispersed message along with the text file on the sheet.

In accordance with another aspect of the present invention there is provided a method for verifying if a document on a sheet of media is an original document, the document having text and a dispersed message thereon and physical indicia, comprising the steps of:

scanning the document so as to obtain a digital file of the physical indicia identifier, a digital file of the text, and the dispersed message;

correlating the physical indicia identifier with the dispersed message so as to obtain a first recovered common data;

distilling the digital text file in accordance with a predetermined program so as to obtain a second common data;

comparing the first common data with the second common data for determining if the document is an authentic original document.

In accordance with yet another aspect of the present invention there is provided a method for verifying if a candidate document on a sheet of media is

an original document, the media having a physical indicia identifier and an identification number, the physical indicia identifier having an associated digital scan file of the physical indicia identifier that has been stored on a memory storage device separate from the sheet of media, comprising the steps of:

5   scanning the physical indicia identifier on the candidate document so as to obtain a digital scan file;

obtaining the associated digital scan file using the identification number; and

comparing the digital scan file with the stored associated digital

10   file stored on the memory storage device for verifying if the candidate document is an original.

In still another aspect of the present invention there is provided a method for verifying if a candidate document on a sheet of media is an original document, comprising the steps of:

15   obtaining a high resolution scan of the physical indicia identifier that is present on a sheet of media that is to be used to create an original document so as to create a scan digital file;

storing the digital scan file on a memory storage device;

associating the digital scan file to an identification number printed

20   on the sheet of media,

printing text on the sheet so as to form the original document;

scanning the physical indicia identifier on a candidate document so as to obtain a second digital file; and

comparing the second digital file with the first digital file to verify

25   if the candidate document is the original document.

In still yet another aspect of the present invention there is provided a method for verifying that a document on a sheet of media is an original, the sheet of media having a physical indicia identifier and an identification number printed thereon, comprising the steps of:

obtaining a high resolution scan of the physical indicia identifier and creating a digital file of the high resolution scan;

associating the high resolution scan file to the identification number printed on the sheet of media,

storing the high resolution scan file to memory,

creating a digital text file to be printed on the sheet,

distilling the digital text file,

creating a message image using the distilled text file,

combining the message image with the high resolution scan file of physical indicia identifier so as to create a dispersed message, printing the dispersed message along with the text file on the sheet;

scanning the document so as to obtain a digital file of the physical indicia identifier, the digital text file of the document, and the dispersed message;

correlating the physical indicia identifier with the dispersed message so as to obtain a recovered message;

distilling the digital file in accordance with a predetermined program that was used to create the message image so as to obtain a candidate message; and

comparing the candidate message with the recorded message for determining if the document is an authentic original document.

In another aspect of the present invention there is provided a kit for making an authenticable original document comprising:

at least one sheet of media having a physical indicia identifier formed thereon and an identification number printed on the sheet of media;

a memory storage device have a digital file of a high resolution scan of the physical indicia identifier stored thereon, the physical indicia identifier being associated with the identification number.

In still yet another aspect of the present invention there is provided a system for verifying that a candidate document is an original document, comprising:

a scanner for scanning the candidate document for obtaining a high resolution scan of a physical indicia identifier formed on the document, the document having an identification number associated with a stored high resolution scan of the physical indicia identifier;

5   a computer for accessing the stored high resolution scan using the identification number and for comparing the high resolution scan obtained by scanning with the stored high resolution scan for verification that the candidate document is the original document.

In yet another aspect of the present invention there is provided a
10   method for making media on which is used for making an authenticable original document, comprising the steps of:

providing a predetermined amount of media;

forming a three dimensional physical indicia identifier on the predetermined amount of media.

15   In still yet another aspect of the present invention there is provided a media on that is used for making an authenticable original document, the media having a three dimensional physical indicia identifier formed thereon, the media being made of a material such that when the three dimensional physical indicia is digitally scanned a unique digital file is produced.

20   These and other aspects, objects, features, and advantages of the present invention will be more clearly understood and appreciated from a review of the following detailed description of the preferred embodiments and appended claims, and by reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

25   In the detailed description of the preferred embodiments of the invention presented below, reference is made to the accompanying drawings in which:

Fig. 1 is a schematic of a sheet of media having pre-formed physical indicia identifier made in accordance with the present invention;

Fig. 2 is a schematic diagram illustrating how a sheet of media having pre-formed physical indicia identifier is made in accordance with the present invention;

Fig. 3 is a schematic diagram illustrating a second embodiment of how a sheet of media having pre-formed physical indicia identifier is made in accordance with the present invention;

Fig. 4 is a partial view of Figs. 2 and 3 illustrating how a sheet of media having pre-formed physical indicia identifier is made in accordance with the present invention;

Fig. 5 is a flow chart illustrating the operation of the overall system made in accordance with the present invention;

Fig. 6 is a schematic diagram of a system made in accordance with the present invention;

Fig. 7 is a flow chart of the operation of the system of Fig. 6.

Fig. 8 is a completed document made using the sheet of Fig. 1;

Fig. 9A is a flow chart illustrating one method on how the document of Fig. 8 is verified; and

Fig. 9B is a flow chart illustrating another method on how the document of Fig. 8 is verified.

DETAILED DESCRIPTION OF THE INVENTION

The invention utilizes aspects of data embedding. The science of data embedding is also referred to as data hiding, information hiding, data embedding, watermarking, and steganography. A data embedding technique is disclosed in Honsinger, et al., US Patent 6,044,156, which is incorporated herein by reference.

Referring to Fig. 1, there is illustrated a sheet 10 for making a document in accordance with the present invention. Sheet 10 may be a print medium such as photosensitive, ink-jet, or thermal transfer media uniquely fingerprinted with a physical indicia identifier 15. The physical indicia identifier 15 is a unique physical feature formed in the front or back surface or an integral

part of the structure of the sheet 10. For example, the physical indicia identifier 15 can be but is not limited to an embossed, etched or engraved indicia or a discernable physical characteristic on the front and/or back surface of the sheet 10 and not duplicatable using known visual copying techniques. The physical

5   indicia identifier 15 may or may not be visible to the unaided eye. Sheet 10 is also printed with a unique identification number 20. The identification number 20 may be a human and/or machine-readable code, for example an alphanumeric or a bar code.

           Referring now to Fig. 2, there is illustrated a schematic diagram of

10   an apparatus for making the sheet 10 of media 41 having the physical indicia identifier 15 and identification number 20. It is well known to those in the art of manufacturing resin-coated media that a resin such as polyurethane or polyethylene is heated to above the glass transition point then applied to a base 40 such as paper or plastic via a hopper 42. After the resin has been applied to the

15   base, the base is run through a set of chilled rollers 44 where the resin is evenly spread over the surface of the base 40 and hardened. The resulting base 40 can be used to manufacture media 41 in the form of thermal, photosensitive paper or inkjet paper. The type of media 41 being manufactured can determine whether the physical indicia identifier 15 is formed on the front or back surface. For example

20   if the media 41 is of the thermal type having a resin overcoat, the physical indicia identifier 15 may be formed on the top surface. If the media 41 is photosensitive paper where an emulsion is coated on a resin coated base, the physical indicia identifier 15 may be formed on the back surface. If the media 41 is inkjet paper, which may or may not have a resin coating, the embossing may be used to form

25   the physical indicia identifier 15 on either the back or front surface. In the case where the media 41 is manufactured in a roll 46 to roll 47 process as shown in Fig. 2, the base 40, after the resin has been coated, passes through a set of physical indicia identifier forming rollers 48. Referring to Fig. 4, there is illustrated an enlarged partial view of Figs. 2 and 3. The rollers 48 contain

30   heating elements 50 similar to the heating elements used in thermal heat heads

such as those used in a KODAK ds 8650 PS Color Printer. As the media 41 passes between the rollers' heating elements 50 the heat from the heating elements 50 form a specified three-dimensional pattern of the physical indicia identifier 15. A logic control unit, such as computer 45 controls the heating

5   elements to provide successively different physical indicias. This allows the forming of a unique physical indicia identifier 15 for each sheet. After the physical indicia identifier 15 is formed in the surface of the resin coating a high-resolution scan is made via a scanner 52 and/or 54. In addition, an identification number 20 is printed on either the front or back surface of the media 41 via a

10   printer 56 or a printer 58 located on the roller 48 and/or roller 49 respectively. In the embodiment illustrated, the high resolution-scan is on the order of 1200 dots/inch. The results of the high resolution-scan are stored in memory, for example in memory of computer 45 or on a memory storage device such as on a CD 25 (shown in Fig. 6) via a computer 45 along with the identification number

15   20. The method used for obtaining the high-resolution scan will be explained later. While in the particular embodiment illustrated the results of the scan is stored on a CD, it may be stored in any desired memory storage device or location. For example, but not limited to a computer disc, memory stick, memory card, or an internet accessible URL address such as a web site.

20   Fig. 3 illustrates a schematic diagram of an apparatus made in accordance with the present invention wherein the media 41 is cut into a plurality of cut sheets 43 each having a physical indicia identifier 15 and identification number 20 as previously discussed. Like numerals in Fig. 3 indicate like parts and operation as previously discussed with respect to Fig. 2. The media 41 is fed

25   from the roll 46 via a set of drive rollers 55 and 57 through the set of rollers 48 and 49. These rollers 48 and 49 contain either heating elements 50 or embossers (not shown). As the media 41 passes between the roller 48 and 49 the embossing roller form the specified pattern of the physical indicia identifier 15. As each unique physical indicia identifier 15 is formed in the surface of the media 41 the

30   high-resolution scan is made via the scanner 52 or 54 and the identification

number 20 is printed on either the front or back surface of the media 41 via printer 56 or a printer 58. After the physical indicia identifier 15 has been formed and the identification number 20 printed on the media 41, the media 41 is cut into sheets 10 via a cutter assembly 60. Each sheet 10 having its' own distinct

5   physical indicia identifier 15, identification number 20, which is associated with a unique scan of the identifier 15. Typically this is accomplished by a computer associating the scanned digital file with the identification number 20 and storing this information in a memory device.

        Referring to Fig. 5, a flow chart illustrates a method for making an

10   original document using sheet 10 in accordance with the present invention. A sheet 10 is provided at step 100. The identification number 20 is printed on sheet 10 and the physical indicia identifier 15 is formed on the sheet 10 at steps 110 and 120 respectively. A high-resolution scan of the physical indicia identifier 15 is made and a digital file of the high-resolution scan is created at step 130. The

15   digital file of the high-resolution scan is linked to the sheet 10 via the printed identification number 20 at step 140. The high-resolution scan provides a unique digital file with respect to physical indicia identifier 15. The digital file of the high-resolution scan of the physical indicia identifier 15 is stored in memory such as written to a CD 25 (shown in Fig. 6) at step 150 and is associated with the

20   unique identifier number 20. A digital file that is to be later printed on the sheet 10 is created at step 160. In the particular embodiment illustrated, the digital file is a text file 165, however, the digital file may be an image file or mixture of text and image files. For the purposes of the present invention a text file shall mean a text file, an image file, or a combination of text and image files. If the text file

25   165 is large, it may be distilled at step 170 to a smaller representation called a distilled digital text file 175 using hash algorithms. These algorithms are utilized widely in computer systems. An example of a known hash algorithm is the Secure Hash Algorithm (SHA) of National Institute of Standards and Technology (NIST). With this algorithm it is possible to distill a large data set to 160 bits,

30   rendering the probability of any two documents having the same hash value

astronomically small. Modern watermarking technologies can easily hide this
amount of data.

Using the distilled digital text file 175 and an algorithm on CD 25
a message image 185 is created at step 180. Briefly, the message image 185 is
5   obtained taking the distilled image and scrambling it into a predetermined
pattern/template. An example of obtaining this message image is described in
greater detail in U.S. Patent Serial No. 09/613,989, entitled: Authenticable Image
With An Embedded Image Having A Discernible Physical Characteristic filed on
July, 11, 2000 by Chris W. Honsinger, and US Patent 6,044,156 both of which are
10   incorporated herein by reference. The message image 185 is combined with the
high-resolution scan file of the physical indicia identifier 15 at step 190. One
method of combining is convolving. An example of convolving is described in
co-pending U.S. Patent application _____ [Docket No. 82834/PCW], filed on
_____, entitled: SELF AUTHENTICATING MEDIA USING A PUBLIC
15   FIBER CARRIER AND AN AUXILIARY PRIVATE CARRIER and filed in the
name of Chris W. Honsinger and David L. Patton, which is hereby incorporated
by reference. From Fourier theory, spatial convolution of two functions in the
frequency domain is the same as adding together the functions phases while
multiplying their respective Fourier amplitudes. Therefore, the effects of
20   combining the message with a carrier, such as by the described convolution
technique, distributes the message energy in accordance with the phase of the
carrier and to modulate the amplitude spectrum of the message with the amplitude
spectrum of the carrier. If the message image were a single delta function and the
carrier of random phase and of uniform Fourier magnitude, the effect of
25   convolving with the carrier would be to distribute the delta function over space.
The Fourier magnitude would maintain its shape because the carrier is of uniform
amplitude spectrum. If the amplitude of the convolved delta function is lowered
in the space domain, the convolution may be viewed as a way to redistribute
energy over space in an invisible way. The effect of convolving an arbitrary
30   message with a random phase carrier is to spatially disperse the message energy

over the image. In this sense, the convolution is a dispersive process. The message image 185 combined or convolved with the high resolution scan file of the physical indicia identifier 15 creates a dispersed message 195 at step 190 and the dispersed message 195 along with the text 36 is printed on the sheet 10 at step 200. Due to the convolution step only the text 36 will be seen and the dispersed message 195 will not be seen by the unaided eye.

Referring now to Fig. 6, the sheet 10 containing the physical indicia identifier 15 and identification number 20 is placed into a printer 22 such as an inkjet or thermal printer. A compact disc (CD) 25 containing the digital file of the high-resolution scan of the physical indicia identifier 15 is placed into a computer 30. The digital file of the high-resolution scan of the physical indicia identifier 15 has previously been associated to the sheet 10 via the identification number 20. The high-resolution scan of the physical indicia identifier 15 can also exist on a remote server located at a service provider and be accessed via a communication network such as the Internet 33. The high-resolution scan of the physical indicia identifier 15 can also exist in any type of memory such as a floppy disk, DVD, hard drive, portal hard drive, etc. and delivered to the computer 30 by any appropriate means.

Now referring to Fig 7, there is illustrated a flow chart showing how a user creates an original document 34 shown in Figs. 6 and 8 made in accordance with the present invention. The user places the sheet 10 into the printer 22 and the CD 25 into the computer 30 at step 220. A software program in the computer 30, typically obtained from the CD 25, asks the user for the identification number(s) 20 for the sheet(s) 10 at step 230. The user enters the identification number 20 via a keyboard 32 (shown in Fig. 6) at step 240. If there is more than one sheet required for printing the document, the correct identification number 20 for each sheet placed into the printer and the additional sheets are entered into the computer in the order they will be printed. Using a word processor such as Microsoft Word or Claris Works, the user creates the text file, which is to be printed on the sheet 10 at step 250. The software using the

physical indicia identifier high-resolution scan file 15 and the digital text file
creates the dispersed message at step 260 which was previously described in
greater detail with respect to steps 160, 170, 180 & 190 of Fig. 5. The digital text
file 165 with the dispersed message 195 intermixed therein is printed on the

5   selected sheet(s) at step 270 creating only one original document 34 at step 280 as
shown in Figs. 6 and 8 that cannot be counterfeited using standard duplicating
methods.

          Now referring to Fig. 8, there is illustrated the completed
document 34 made in accordance with the present invention. The completed

10   document 34 comprises the physical indicia identifier 15, the identification
number 20, the text 36, and the dispersed message 195, which is not normally
visible as it is intermixed with the text 36.

          Now referring to Fig. 9A, there is illustrated a flow chart of one
method on how a document is verified in accordance with the present invention.

15   A digital scan of the physical indicia identifier 15 is made at step 285. The
identification number is used to find the previously scanned information of the
physical indicia identifier 15 on CD 25 at step 290. This stored information is
compared with the information obtained by scanning of the physical indicia
identifier 15 on document at step 295. If the scanned information regarding the

20   physical indicia identifier 15 is the same as the stored information the document
is verified at decision block 296 as being an original at step 297, otherwise the
scanned document cannot be verified at step 298.

          Referring to Fig. 9B there is illustrated a flow chart of another
method on how a document is verified in accordance with the present invention.

25   In this method two different techniques are used to derive the same common data
such that the common data obtained by the two different techniques must
correspond in order to verify that the document is an original. A digital scan of
the document 34 is made at step 300 and using appropriate algorithms on CD 25,
the physical indicia identifier 15, the text 36, and the dispersed message 195 are

30   obtained. The physical indicia identifier 15 is located and the dispersed message

195 is obtained at step 310. By using the data embedding and extraction algorithm described in detail below, the physical indicia identifier 15 is processed in the Fourier domain to maintain phase and flatten the Fourier magnitude. This result is inverse Fourier transformed to obtain a carrier, which is then correlated

5   with the dispersed message 195 as found by step 190 previously discussed in Fig. 5. The physical indicia identifier 15 is correlated with the dispersed message 195, and the message image 185 is recovered at step 330. Now, the message image 185 recovered at step 330 should correspond to the candidate message image 410 (text file) that is to be validated.

10   To obtain the candidate message image 410, the text file 405 is extracted at step 340 from the scan done at step 300. An optical character-recognition (OCR) algorithm extracts the digital file 405 of the text at step 340. It is understood that OCR is one example of a text recognition algorithm and there are many others that can be used. Using the same hash algorithm, text file

15   405 is distilled at step 350. This distilled text is used to create a message image as discussed with respect to Fig. 5 to form a candidate message image 410 at step 360. A decision of validity is made at decision block 370 by comparing the value of the candidate message image 410 obtained at step 360 with the message image 185 recovered at step 330. If the candidate message image 410 is the same as the

20   recovered message image 185 recovered at step 330, the document is validated at step 390. Otherwise the document is not validated at step 380. As can be seen in this method two distinct techniques are used to obtain a common data. In one method the common data is obtained starting from the beginning of the method of Fig. 5. In the second method using the scanned document and starting at the end

25   of method of Fig. 5 and working backwards, the common data is obtained. In the embodiment illustrated the common data is the message image, however, the common data could have been the distilled text file. In such case after step 330, the distilled text file could have been obtained using the appropriate algorithm. This could have been compared with the data obtained at step 350. All that is

30   important is that the common data is obtained using one method starting from the

beginning and compared with the common data is starting from the other end of the process.

The invention has been described in detail with particular reference to certain preferred embodiments thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention.

PARTS LIST

10	sheet
15	physical indicia identifier
20	identification number
22	printer
25	CD
30	computer
32	keyboard
33	Internet
34	document
36	text
40	base
41	media
42	hopper
43	cut sheets
44	chilled roller
45	computer
46	roll
47	roll
48	indicia identifier forming rollers
49	indicia identifier forming rollers
50	heating elements
52	scanner
54	scanner
55	drive roller
56	printer
57	drive roller
58	printer
60	cutter assembly

100	step
110	step
120	step
130	step
140	step
150	step
160	step
165	digital text file
170	step
175	distilled digital text file
180	step
185	message image
190	step
195	dispersed message
200	step
220	step
230	step
240	step
250	step
260	step
270	step
280	step
285	step
290	step
295	step
296	decision block
297	step
298	step
300	step
310	step

320	step	
330	step	
340	step	
350	step	
360	step	
370	decision block	
380	step	
390	step	
405	digital text file	
410	candidate message image	